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Perspectives

Fall 2011

Konza provides window into climate change

Grasslands are expected to be one of the first ecosystems to respond to climate change. That's why four university distinguished professors at Kansas State University are taking a closer look at elements of the Konza Prairie ecosystem.

(continued on back cover)

Konza research impacts global grasslands

Kansas may be an ocean away from southern Africa, but Kansas State University researchers are shrinking the distance through an unlikely connection: grasslands.

The southern African grasslands and savannas have much in common with the grasslands of the central United States, but the African grasslands are more interconnected to the people's way of life.

David Hartnett, university distinguished professor of biology, conducts ecological research in southern Africa, primarily in Botswana and South Africa. He leads research trips to southern Africa with Kansas State University graduate and undergraduate students. He was a visiting professor at the University of Botswana in 2002 as a Fulbright senior scholar.

"In developing countries in southern Africa, the well-being of the people is directly tied to the ecological health of the grasslands," Hartnett said. "They're getting everything from the grasslands: their livestock, fiber, food, fuel. If something

ecologically devastating happened to the grasslands, it would have an immediate, drastic, direct impact on the people."

A recent international project included working with the University of Botswana to study mesquite, an invasive plant species that's causing ecological and economic problems. Scientists are investigating why mesquite, native to the southwestern United States, is growing in the grasslands in southern Africa.

The trees are using so much soil water that they're depleting the domestic water supply, competing with the grasslands for water, and reducing forage for livestock. It's even causing tension at the border between South Africa and Botswana.

"The mesquite has grown into dense thickets and provides visual cover and protection for thieves going across the border from South Africa into Botswana who steal livestock," Hartnett said. "It wasn't a problem when the grassland was wide open."

Kansas State University researchers want to design proper management practices, but they also want to compare grassland patterns and processes in North America and southern Africa to see if general ecological rules being discovered in Kansas apply to grasslands worldwide.

The annual practice of burning grasslands in the Flint Hills of Kansas, for example, enhances the productivity of livestock, but that rule may not apply to all grasslands.

"We developed a bunch of rules here in the Flint Hills on how grasslands respond to things like climate variability, fire and the presence or absence of grazers," said John Blair, university distinguished professor of biology. "We want to know if those same rules apply to grasslands in China, South America, Africa and around the world. The southern African grasslands give us the opportunity to test the generality of our theories."

— Trevor Davis

Many researchers working at the Konza Prairie in the Flint Hills of northeastern Kansas find it hard not to appreciate the tallgrass prairie — whether it's for the Konza's natural beauty or its scientific value.

"There's a lot more to a grassland system than what meets the eye," said David Hartnett, university distinguished professor of biology. "You'd never think just driving by on Interstate 70 that there are about 600 species of plants on the Konza Prairie."

Kansas State University is celebrating the 40th anniversary of the Konza Prairie Biological Station. Jointly owned by the Nature Conservancy and Kansas State University and managed by the university's Division of Biology, the Konza Prairie Biological Station spans about 8,600 acres, with 93 percent of the prairie having never been plowed. It was first developed as an ecological research site in 1971 under the leadership of the late Lloyd Hulbert, a biology professor at Kansas State University.

"Very few universities have a world-class field research facility that's a mere 10 minutes from campus," Hartnett said. "The fact that such a fine facility is so close to campus is one of the reasons we attract dozens of visiting scientists. We have the infrastructure and facilities to support that research."

The station hosts about 130 registered research projects from nearly 150 scientists, and it has been one of the National Science Foundation's Long-Term Ecological Research sites since 1980.

"The Konza site was designed as a large fire and grazing experiment and is set up like no other place in the world," said John Blair, university distinguished professor of biology. "We attract grassland researchers from around the globe because there's a wealth of supporting information where they can build new studies. We have more than 30 years worth of data on a wide range of ecological processes at the Konza."

Grasslands such as the Konza appeal to scientists because they are ideal for experimentation.

"In other ecosystems, say a New England forest or a tropical rain forest, it's much harder to study those environments in terms of experimental manipulation, but in grasslands you can conduct experiments," Hartnett said.

Grasslands are easily manipulated and respond quickly to environmental changes, and the shorter stature of grasses allows researchers to easily set up experiments.

"Plants in the grasslands turn over fairly quickly, so you can see things happen in a decade that might otherwise take a century in another ecosystem," Blair said. "This is why grasslands provide the basis for much ecological theory."

Grasslands, which cover about 40 percent of Earth's surface excluding Antarctica and Greenland, are also the center for the world's agriculture activities. Many native grasslands have been replaced with cultivated fields or are fragmented by other land uses.

"Grasslands by far exceed every type of ecosystem in terms of providing food, services and resources to humans," Hartnett said. "Grasslands are the most important global ecosystem for humans."

The tallgrass prairie is North America's most endangered ecosystem. Only about 4 percent of the world's original tallgrass prairie remains, and Kansas State University researchers work to conserve, manage and restore these grasslands.

"Grasslands are extensively used for agriculture and other land-use practices, but there aren't the kind of large preserves set aside like there are for tropical rain forests," Blair said. "Grasslands are subject to many environmental changes and threats, and we must protect them."

— Trevor Davis

Kansas State University's backyard: **A SEA OF GRASS**

Konza Prairie celebrates 40 years of uncovering nature's secrets



Roaming research

Bison on Konza Prairie fuel experiments to restore prairie ecosystems



QR code links to a video about bison studies on the Konza.



The presence of bison at Konza Prairie Biological Station may seem iconic, a tribute to America's past when such herds roamed the range.

But the bison at Konza serve an important purpose by furthering the efforts of numerous experiments currently being conducted on-site, according to Kansas State University's John Briggs, director of the tallgrass prairie preserve.

"For example, we have a large group of individuals from a variety of universities who are comparing how one native ungulate, bison, impacts the tallgrass prairie versus native ungulates in South Africa, where they have many species grazing — everything from elephants to the smaller antelopes," Briggs said.

The main objective in several of the Konza experiments is learning about the tallgrass prairie ecosystem by using the grazing patterns of bison.

The role of the bison, Briggs said, is similar to the various burning treatments conducted annually at Konza.

"We're using the bison much like a treatment, just like fire," he said. "They're part of our long-term experimental design. Although Konza is large, it's really not large enough to study natural herds of bison. It's not really a good place to study the behavior of animals."

Briggs says one of the challenges with conducting research on the bison is their constant potential for unpredictable behavior.

"They're not like cattle," he said. "They're very wild animals, so we have very strict protocol when people work with

the bison. We never let people go in the bison area by themselves, and everyone is required to carry a radio with them. We haven't had any incidents with the bison, but they are unpredictable."

Much like a list of sports statistics, the biological history of Konza Prairie's bison herd is known inside and out.

With 30 bison introduced to the area in October 1987, the herd has grown to an average size of 294, mostly through natural reproduction. The heaviest bison in the herd weighed in at 2,050 pounds in 2006. Female bison in the herd can be up to 20 years old, while the males are only kept up to age 8.

Researchers also have found that the bison gain more weight in years with greater late-August precipitation but gain less weight in years with greater late-June, early-July precipitation. The bison also lose approximately 10 percent of their body mass over the winter — except for the calves, which gain around 3 percent of their body mass.

Bison prefer to eat grasses and their grazing increases the local plant diversity. They also prefer to graze in recently-burned areas during the growing season but prefer unburned areas in the winter. Grazing by the bison increases the abundance of forb-feeding grasshoppers. It also increases the abundance of upland sandpipers and grasshopper sparrows on the prairie while lowering the number of Henslow's sparrows and dickcissels.

This level of factual data about the herd only further drives academic traffic to Konza Prairie, Briggs said.

"We have a lot of information on this herd," he said. "We know the performance level, and that's what attracts researchers. They know when they come here that we have a lot of background information for them so they can set up their experiments easily."

These grazing experiments, in addition to the plethora of other experiments being conducted on Konza, could lead to the conservation and possible restoration of the tallgrass prairie, which is an endangered ecosystem, Briggs said.

"We're kind of spoiled here in Kansas because we have so many prairie lands around us," he said. "However, some conservation experts think the tallgrass prairie is one of the most endangered ecosystems in North America, and that grasslands and savannas worldwide are threatened, too."

"The problem with grasslands is that they're wonderful places to grow our agriculture crops. Much of the original extent of tallgrass prairie has been converted to croplands, so there's only this small little remnant of tallgrass still left in Kansas. We really need to understand this ecosystem and its importance before it's lost, because once it is lost, it's gone forever."

(continued from front cover)

Rain

John Blair, university distinguished professor of biology, set up rain-out shelters at the Konza to manipulate the timing of rainfall and simulate future climate conditions. He's investigating the effect of warmer temperatures and precipitation variations.

"Grasslands responded to past climate changes like the droughts of the 1930s that led to the Dust Bowl and droughts of the 1950s that altered the distribution of many grassland species in North America, and they're likely to be some of the first systems to respond to contemporary climate change," he said.

Soil

Chuck Rice, university distinguished professor of agronomy, studies the exchange of carbon and nitrogen between soil and plants, particularly tallgrass species. He's working to establish soil carbon sequestration as a promising method for mitigating greenhouse gases. As more carbon dioxide is converted by plants into soil organic carbon, greenhouse gas levels are reduced.

"As far as agriculture goes, new practices like no-till farming are helpful no matter what you believe," Rice said. "We reduce carbon dioxide in the atmosphere, improve the health and quality of the soil, and reduce tillage and energy use. That's financially beneficial to the farmer no matter what."

Rice served with more than 2,000 climate change experts to write reports for the Intergovernmental Panel on Climate Change, which received a share of the 2007 Nobel Peace Prize with Al Gore. The Nobel Prize Committee recognized the United Nations panel for its efforts to spread awareness of man-made climate change and to lay the foundations for counteracting it.

Animals

Tony Joern, university distinguished professor of biology, is examining the role of temperature in driving grasshopper performance and interactions with their spider predators.

Spiders are connected indirectly to climate and plants. A spider's hunt for grasshoppers depends on the temperature. If the temperature is too hot, a spider stays in the shade and does not feed on grasshoppers. The grasshoppers are able to eat plants without being hunted. Under warmer temperatures, grasshoppers could consume more vegetation because they interact less with spiders.

Water

Walter Dodds, university distinguished professor of biology, has studied waterways in the Konza and other environments like rain forests and deserts to demonstrate that nitrous oxide emissions from rivers and streams around the world make up at least 10 percent of human-caused nitrous oxide emissions — three times greater than current estimates by the climate change panel. Nitrogen pollution on former grassland streams contributes much of the emission of this potent greenhouse gas.

— Trevor Davis

